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**PEO(TAD)
TECHNOLOGY NEED FOCUSING-
SHIP SELF DEFENSE (SSD)**

**PEO(TAD) / PEO(SC/AP)
INDUSTRY DAY**

31 July 1997

OUTLINE

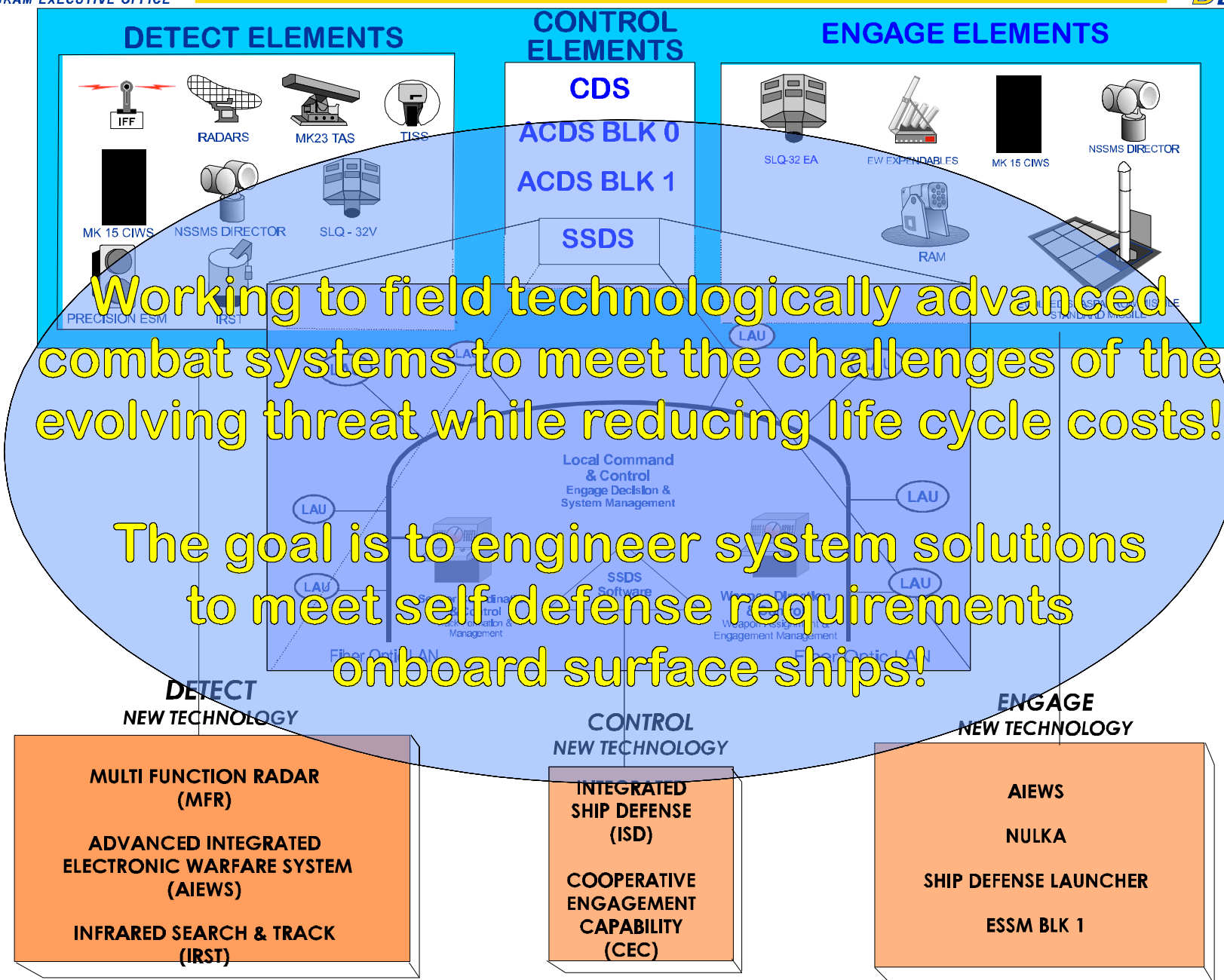
- **What is Ship Self Defense**
 - **Environment**
 - **Business**
 - **Acquisition**
 - **Improvements**
- **Technology Needs**
- **Summary**

SHIP DEFENSE IN THE LITTORALS

The diagram illustrates a complex maritime defense system in the littorals. Key elements include:

- AWACS** (Air Warning and Control System) and **E2-C SURVEILLANCE** aircraft providing command and control.
- JOINT US / ALLIED BATTLE GROUP** and **AMPHIBIOUS GROUP** consisting of various naval vessels.
- CV BATTLE GROUP** and **CV LAUNCHED STRIKE** aircraft.
- COMMERCIAL AIR LANES** and **COOPERATIVE ENGAGEMENT** zones.
- SELF DEFENSE** and **AREA DEFENSE** capabilities.
- ENEMY COASTAL SHIP ATTACK** and **ENEMY SUB ASCM ATTACK** (Anti-Ship Cruise Missile).
- ENEMY GROUND LAUNCHED MISSILES** and **ENEMY HELO** (Helicopter).
- ENEMY AIR ATTACK** and **ENEMY JAMMING** capabilities.
- COMMERCIAL AIR LANES** and **JOINT US / ALLIED BATTLE GROUP** (repeated).
- CV LAUNCHED STRIKE** and **AMPHIBIOUS GROUP** (repeated).
- COMMERCIAL AIR LANES** and **COOPERATIVE ENGAGEMENT** (repeated).
- SELF DEFENSE** and **AREA DEFENSE** (repeated).
- ENEMY COASTAL SHIP ATTACK** and **ENEMY SUB ASCM ATTACK** (repeated).
- ENEMY GROUND LAUNCHED MISSILES** and **ENEMY HELO** (repeated).
- ENEMY AIR ATTACK** and **ENEMY JAMMING** (repeated).
- COMMERCIAL AIR LANES** and **JOINT US / ALLIED BATTLE GROUP** (repeated).
- CV LAUNCHED STRIKE** and **AMPHIBIOUS GROUP** (repeated).
- COMMERCIAL AIR LANES** and **COOPERATIVE ENGAGEMENT** (repeated).
- SELF DEFENSE** and **AREA DEFENSE** (repeated).
- ENEMY COASTAL SHIP ATTACK** and **ENEMY SUB ASCM ATTACK** (repeated).
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- ENEMY AIR ATTACK** and **ENEMY JAMMING** (repeated).

SHIP SELF DEFENSE BUSINESS

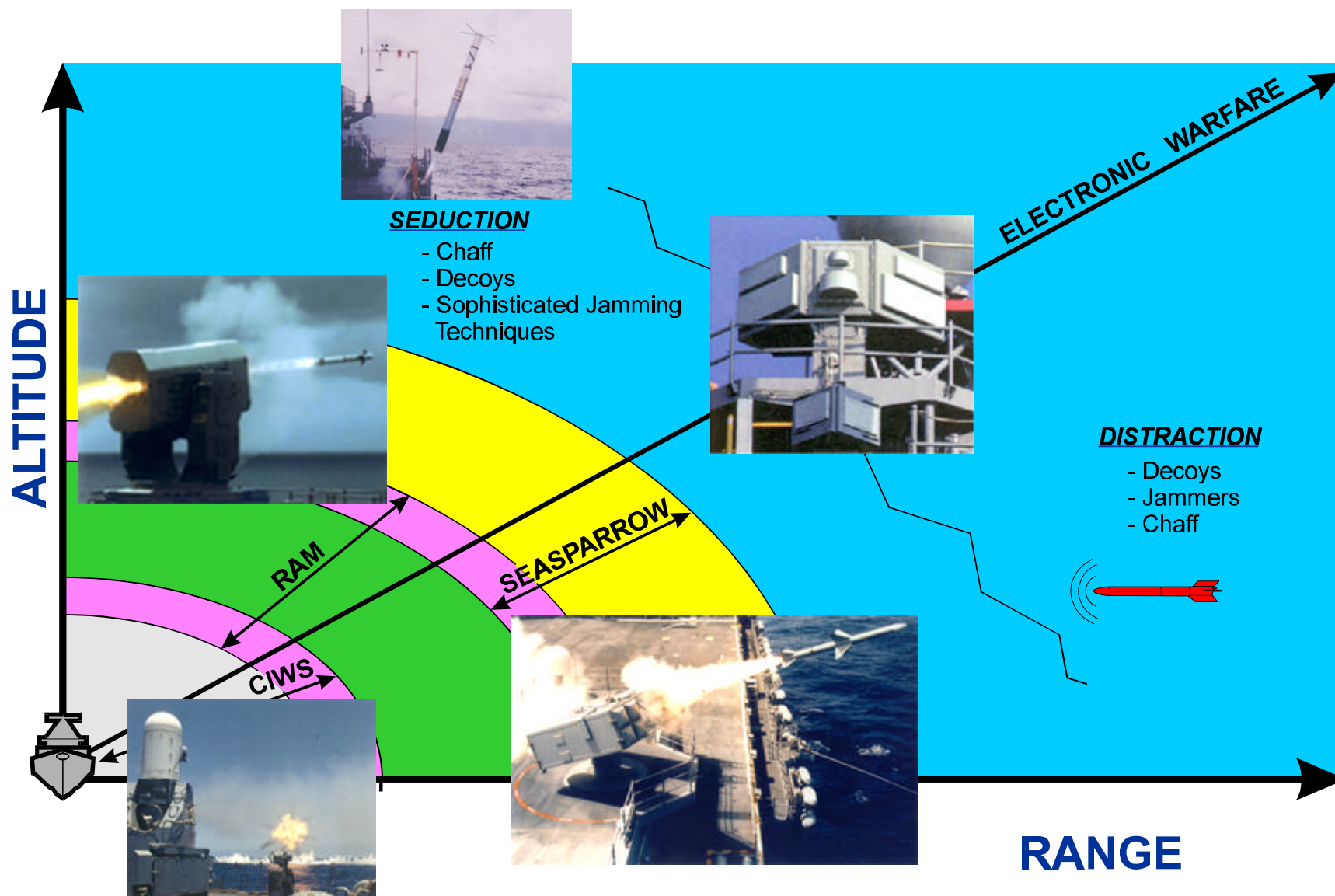


REQUIRED SHIP SELF DEFENSE COMBAT SYSTEM ATTRIBUTES

- Automated detect-to-engage
- Tailorable to tactical situation
- Sensor correlation
 - Common tactical picture
 - Reduced reaction time
 - Countermeasure resistance
- Threat reactive
 - Automation
 - Flexible doctrine control
 - Integrated softkill / hardkill engagement

Applicable to multiple ship classes

**THEATER
AIR
DEFENSE**



SHIP SELF DEFENSE ENGINEERING PHILOSOPHY

ADD EXISTING SYSTEMS	INTEGRATE SHIP DEFENSE ELEMENTS	DEVELOP ADVANCED CAPABILITIES
<ul style="list-style-type: none"> • PROCURE AND INSTALL SYSTEMS/UPGRADES ALREADY DEVELOPED: <ul style="list-style-type: none"> – CIWS HOLC, SURF. MODE, R&M – RIM 7P – RAM + IRMU – AN/SPS-49 MPU – SIGNATURE REDUCTION 	<ul style="list-style-type: none"> • MULTI-SENSOR INTEGRATION <ul style="list-style-type: none"> – FREQUENCY DIVERSITY – IR / RF SYNERGISM – ESM CUEING – IMPROVED TARGET ID • AUTOMATED DETECT-TO-ENGAGE • MULTI-WEAPON CONTROL • HK / EW COORDINATION • AN/SLQ-32 • CEC 	<ul style="list-style-type: none"> • LEVERAGE NEW TECHNOLOGY <ul style="list-style-type: none"> – ACTIVE PHASED ARRAY – IR FOCAL PLANE ARRAY – PRODUCT IMPROVEMENTS – MISSILE GUIDANCE / FUZING / PROPULSION – OFFBOARD ACTIVE COUNTERMEASURES • NEW SYSTEMS <ul style="list-style-type: none"> – PRECISION ESM – AN/SPQ-9B – IRST – EVOLVED SEASPARROW – SD LAUNCHER – AN/SLY-2 (AIEWS)

WHAT SHIP SELF DEFENSE IS DOING

- Acquisition Strategy to field the systems
 - Improve warfighting capabilities
 - * Integrate apertures
 - * Infuse new technology
 - * Design for technology upgrades
 - Reduce life cycle cost
 - * Integrate legacy systems
 - * Reduce number of legacy systems
 - * Design for open systems architecture
 - * Commonality within PEO(TAD) and DoD

SHIP SELF DEFENSE TECHNOLOGY OPPORTUNITIES

- Technology needs
 - Integrated topside design
 - Multifunction multiband RF system
 - Advanced beam director
 - Advanced sensor design
 - Radar sensors
 - Common RF module design

TECHNOLOGY NEED: INTEGRATED TOPSIDE DESIGN

FUNCTIONAL REQUIREMENT

- Demonstrate advanced technologies and system architectures that will achieve topside design integration improvements
 - Meet self defense requirements with reduced numbers and/or types of sensor systems (i.e. multifunction systems)
 - Meet self defense requirements with reduced numbers and/or types of weapons systems
 - Achieve substantial reduction in overall ship signature
 - Achieve substantial reduction in ship manning requirements
 - Achieve substantial reductions in combat system life cycle costs and / or procurement costs

TECHNOLOGY NEED: INTEGRATED TOPSIDE DESIGN

TECHNOLOGY TO BE DEMONSTRATED

- ATD may demonstrate new systems (either hardware or software) that could include:
 - New or improved sensor systems, such as multifunction RF / IR systems
 - New or improved weapons systems, such as new guidance unit on an existing missile or a new, less expensive multifunction weapon
 - New or improved architecture substantially reducing the number of antenna systems and / or substantially reducing their detectability
 - Materials supporting substantial reductions in the ships signature
- Technology payoff - The ATD may have the following benefits:
 - reduction of EMC problems
 - lower manning and life cycle costs
 - increased performance as a result of integrating system

TECHNOLOGY NEED: MULTIFUNCTION, MULTIBAND RF SYSTEM

FUNCTIONAL REQUIREMENT

- Demonstrate advanced technologies and system architectures that will achieve wideband multifunction RF receiving, transmitting, signal synthesis and aperture / time control
 - Use of common hardware, in particular, common aperture(s) for radar, EW, and communication functions
 - Graceful degradation in performance
 - reduced system life cycle and procurement costs provided by aperture / time sharing of common hardware
 - Smaller overall size and weight than combined separate systems
 - Implementable in airborne and surface platform systems
 - Lower procurement cost
 - Lower life cycle cost

TECHNOLOGY NEED: MULTIFUNCTION, MULTIBAND RF SYSTEM

TECHNOLOGY TO BE DEMONSTRATED

- **Common hardware for radar, EW and communication functions over extremely wide frequency ranges**
 - **Common multiple (digital) receivers**
 - **Multiple common module processors for radar, EW and comms processing**
 - **Multiple common (direct digital) synthesizers and waveform generators for synthesis of coherent RF signals**
 - **Resource manager for controlling demonstration system to perform simultaneous radar, EW and communication functions**
 - **Simultaneous multibeam transmit and receive operation**
- **Technology payoff - The ATD may lead to follow-on development of digital beam forming techniques using true time delay for receive and transmit functions**
 - **Greatly reduced system complexity through use of digital beam forming instead of RF or photonic beam forming componentry**
 - **Most componentry can be remote from receive or transmit antenna elements and housed in controlled environments**

TECHNOLOGY NEED: ADVANCED BEAM DIRECTOR

FUNCTIONAL REQUIREMENT

- **Demonstrate advanced technologies and system architectures that provide a single, simultaneous, multisensor electro-optical beam director**
 - **Incorporate various applications supporting multiple missions in a single system**
 - **Support flexibility required in high technology turnover environment**
 - **Integrate with current systems / architectures**
 - **Must have ability to be easily tailored to specific platform / mission**

TECHNOLOGY NEED: ADVANCED BEAM DIRECTOR

TECHNOLOGY TO BE DEMONSTRATED

- **ATD may demonstrate technology that provides a single, lightweight Electro-Optical director with the following characteristics:**
 - **Accept up to 4 sensors (operator select)**
 - **Provides environmentally shielded housing**
 - **Ease of sensor alignment**
 - **Minimize broadband transmission losses**
 - **Easy integration with SSD and AEGIS**
- **Technology payoff - The ATD may lead to follow-on development of electro-optical systems**
 - **A single EO director**

TECHNOLOGY NEED: ADVANCED SENSOR DESIGN

FUNCTIONAL REQUIREMENT

- Demonstrate advanced technologies and system architectures that provide an advanced, lightweight MWIR sensor prototype to support Thermal Imaging Sensor System (TISS), future beam directors and stabilized pedestals
 - High sensitivity (with resultant increase in detection / track ranges) through optical and signal processing
 - Gaussian output signal available for input to a video tracker
 - High resolution video through oversampling techniques
 - Potential to use optical elements to reduce the effect of stabilization jitter

TECHNOLOGY NEED: ADVANCED SENSOR DESIGN

TECHNOLOGY TO BE DEMONSTRATED

- **ATD may demonstrate technology that will resolve limitations of conventional staring focal plane arrays:**
 - **Bad / noisy detectors - effects are essentially eliminated**
 - **Fixed pattern noise - significant reduction in RMS noise and noise spikes**
 - **Sensitivity - improvement allows detection of extremely weak objects or allows trade-off of system size / weight parameters**
- **Technology payoff - The ATD may lead to follow-on development of advanced sensor systems with an**
 - **Increase in detector yield (reducing costs)**
 - **Increase in performance sensitivity**

TECHNOLOGY NEED: RADAR SENSORS

FUNCTIONAL REQUIREMENT

- Demonstrate advanced technologies and system architectures that will achieve the full range of
 - Radar functions for targets from conventional to stealth
 - Operating at varying ranges and in severe operating conditions (including littoral)
 - Common aperture(s) required for the next generation of ships including
 - * Volume surveillance radar functions, typically at L band
 - * Weapon system control function, typically at X or Ku bands
 - * TBMD radar functions, typically at S band
- Achieve reduced procurement cost
- Achieve reduced life cycle cost

TECHNOLOGY NEED: RADAR SENSORS

TECHNOLOGY TO BE DEMONSTRATED

- **ATD may demonstrate performance in the following areas:**
 - clutter cancellation in the littoral environment which enables the detection of low targets
 - target classification
 - commonality of components (e.g. signal processor for L, S and X band systems)
 - discrimination techniques for TBM targets
- **Technology payoff - The ATD may lead to new radar systems for the next generation of ships**
 - increased performance due to the use of active aperture phased arrays
 - lower cost of ownership due to commonality

TECHNOLOGY NEED: COMMON RF MODULE DESIGN

FUNCTIONAL REQUIREMENT

- Demonstrate advanced technologies and system architectures for advanced RF module designs that will:
 - Meet the requirements for advanced, common, multifunction RF systems onboard both ships and aircraft (e.g. broadband, high power, very large dynamic range,...)
 - Perform radar, EW and communications functions
 - Support or achieve direct digital synthesis and digital reception at the module level, and digital beamforming at the system level.
 - Have substantially reduced procurement costs when compared to existing RF modules
 - Achieve substantial reductions in combat system life cycle costs

TECHNOLOGY NEED: COMMON RF MODULE DESIGN

TECHNOLOGY TO BE DEMONSTRATED

- **ATD may demonstrate the following technologies**
 - wide bandwidth
 - affordability
 - efficiency
 - stability requirements (for clutter cancellation)
 - required power across the band
- **Technology payoff - ATD may be a major step in permitting multifunction RF systems for RADAR, EW and communications. This would result in:**
 - increased performance
 - lower manning
 - reduced life cycle costs

NAVY LABORATORY / INDUSTRIAL PARTNERSHIPS

Possible laboratory partners

- **NRL**
 - Radar Division
 - EW Division
 - **NSWC Dahlgren**
 - Electro-Optics / Radar
- Girard Trunk - (202) 767-2573
Joseph Lawrence - (202) 767-5933
- Stuart Koch - (540) 653-8737

***Strong navy laboratory / industrial cooperation
result in strong proposals***

SUMMARY

Technology insertion opportunities in emerging SSD System intended for new surface platforms

- **Systems**
 - AIEWS
 - MFR / VSR
 - EO (TISS andIRST)
- **Surface Platforms**
 - LPD-22
 - CVN-77
 - DD-21
 - CVX

We are looking for:

- Transition potential
- Improved mission effectiveness (e.g. increased performance, reduced signature)
- Affordability (e.g. reduced manning, reduced life cycle cost, commonality with other DoD systems)